

CLAIMS

What is claimed is:

1. A method for increasing the fault tolerance in a network, said method comprising acts of:

5 associating a plurality of nodes with a sub-network, each of said plurality of nodes capable of sending and receiving data;

adding a plurality of cross layer communication agent capable nodes, herein referred to as CCA-capable nodes, to said sub-network, said plurality of CCA-capable nodes capable of receiving data from and sending data to said plurality of nodes; and

10 determining which one of the plurality of CCA-capable nodes should be assigned to be a gateway CCA, whereby said gateway CCA is used by each one of said plurality of nodes within said sub-network to communicate with the rest of the network.

2. The method of Claim 1, wherein the act of determining further comprises sub-acts
15 of:

designating one of the plurality of CCA-capable nodes as the gateway CCA;

querying the gateway CCA from each node to determine whether it is active and awaiting a response, and when:

the gateway CCA responds, repeating the querying act; otherwise,

20 broadcasting a solicit message for receipt by CCA-capable nodes and awaiting a response, and when:

a CCA-capable node responds, assigning a CCA-capable node as the gateway CCA; otherwise, repeating the broadcasting act.

25 3. The method of Claim 2, wherein when a plurality of CCA-capable nodes respond, selecting from the plurality of CCA-capable nodes responding, a single CCA-capable node for use by all of the nodes as the gateway CCA.

4. The method of Claim 3, wherein the act of selecting from the plurality of CCA-capable nodes responding comprises acts of:

determining a network ID for each of the plurality of CCA-capable nodes responding; and

5 selecting a CCA-capable node having a lowest network ID from each of the plurality of CCA-capable nodes responding as the gateway CCA.

5. The method of Claim 1, wherein said act of determining further comprises acts of: designating one of the plurality of CCA-capable nodes to be a gateway CCA;

10 querying the plurality of CCA-capable nodes, **from each node**, to determine whether they are active and awaiting a response, and when:

the gateway CCA responds, repeating the querying act; otherwise,

changing the CCA-capable node assigned to be the gateway CCA based upon a response from the plurality of CCA-capable nodes.

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6. The method of Claim 5, wherein when a plurality of CCA-capable nodes respond, selecting from the plurality of CCA-capable nodes responding, a single CCA-capable node for use by all of the nodes as the gateway CCA.

20 7. The method of Claim 6, wherein the act of selecting from the plurality of CCA-capable nodes responding comprises acts of:

determining a network ID for each of the plurality of CCA-capable nodes responding; and

25 selecting a CCA-capable node having a lowest network ID from each of the plurality of CCA-capable nodes responding as the gateway CCA.

8. The method of Claim 1, wherein said act of determining further comprises acts of: designating one of the plurality of CCA-capable nodes to be a gateway CCA;

compiling a list of CCA-capable nodes on at least one CCA-capable node;
querying each CCA-capable node, from at least one CCA-capable node, in
the list to determine its state;

5 updating the list of CCA-capable nodes based on a response from each of
the CCA-capable nodes; and

checking for a response from the gateway CCA, and when:

the gateway CCA responds, repeating the querying act; otherwise,

transmitting the list of CCA-capable nodes to the plurality of nodes
in the sub-network; and

10 selecting and assigning a new gateway CCA from the list of CCA-
capable nodes.

9. The method of Claim 8, wherein the act of selecting and assigning a new gateway
CCA comprises acts of:

15 determining a network ID for each of the CCA-capable nodes in the list of CCA-
capable nodes; and

selecting a CCA-capable node having a lowest network ID from the list of CCA-
capable nodes as the gateway CCA.

20 10. The method of Claim 1, wherein the act of determining further comprises acts of:
designating one of the plurality of CCA-capable nodes to be a gateway
CCA;

querying each CCA-capable node, from at least one CCA-capable node, in
the plurality of CCA-capable nodes to determine its state;

25 updating a list of CCA-capable nodes, stored on the at least one CCA-
capable node, based on a response from each of the CCA-capable nodes;
sending, from the at least one CCA-capable node, the list of CCA-capable
nodes to the plurality of nodes in the sub-network;
waiting to repeat the querying act; and

checking, by at least one node in the plurality of nodes, the list of CCA-capable nodes for the gateway CCA, and when:

the gateway CCA is in the list of CCA-capable nodes waiting for the next list of CCA-capable nodes; otherwise,

5 selecting and assigning a new gateway CCA from the list of CCA-capable nodes.

11. The method of Claim 10, wherein the act of selecting and assigning from the list of CCA-capable nodes comprises acts of:

10 determining a network ID for each of CCA-capable nodes in the list of CCA-capable nodes; and

 selecting a CCA-capable node having a lowest network ID from the list of CCA-capable nodes as the gateway CCA.

15 12. The method of Claim 1, wherein the act of determining further comprises acts of:
 designating one of the plurality of CCA-capable nodes to be a gateway CCA;

 broadcasting a message from each CCA-capable node to the plurality of nodes; and

20 selecting a gateway CCA based upon the message from each CCA-capable node.

13. The method of Claim 12, wherein the act of selecting further comprises acts of:
 determining a current hop-count for the message; and

25 comparing the current hop-count to previous hop-counts from previous messages, and when the current hop-count is less than the previous hop-count selecting the CCA-capable node which broadcast the message as a new gateway CCA.

14. The method of Claim 12, wherein the act of selecting further comprises acts of:

determining a current time at which the message was received;
retrieving a gateway time at which a message from the gateway CCA was
received; and
selecting and assigning a new gateway CCA based upon a result of a user-
5 specified formula for comparing the current time and the gateway time.

15. The method of Claim 1, wherein said act of determining further comprises acts of:
designating one of the plurality of CCA-capable nodes to be a gateway CCA;
transmitting a vote from each CCA-capable node to all other CCA-capable nodes
10 designating which CCA-capable node should become a subsequent gateway CCA; and
tallying said votes for each CCA-capable node, and when:
one CCA-capable node receives more votes than any of the other CCA-
capable nodes,
assigning the one CCA-capable node to become the new gateway CCA,
15 otherwise
repeating the transmitting act.

16. The method of Claim 15 further comprising an act of determining if at least 2/3 of
the plurality of CCA-capable nodes are active, and wherein at least 2/3 of the CCA-
20 capable nodes must respond before performing the act of transmitting the vote.

17. The method of Claim 1, wherein the act of associating the plurality of nodes
further comprises an act of associating the plurality of nodes in an ad-hoc manner.

25 18. The method of Claim 1, further comprising an act of providing at least a portion
of the plurality of nodes and CCA-capable nodes that are able to be mobile.

19. A network comprising:

a plurality of nodes, each of said plurality of nodes capable of sending and receiving data, the plurality of nodes forming a first sub-network; and

a plurality of cross layer communication agent capable nodes, herein referred to as CCA-capable nodes, at least one of said plurality of CCA-capable nodes capable of communicating with the plurality of nodes and capable communicating with a second sub-network,

wherein the plurality of nodes and the plurality of CCA-capable nodes communicate to determine which CCA-capable node should be assigned to be a gateway CCA, whereby the gateway CCA is used by each one of the plurality of nodes and the remaining CCA-capable nodes to communicate with the second sub-network.

20. The network of Claim 19 further comprising:

a designation message for designating one of the plurality of CCA-capable nodes as the gateway CCA;

a querying message sent from each node to the gateway CCA to determine whether the gateway CCA is active;

a timeout period where each node waits for a response from the gateway CCA, and when:

the gateway CCA responds, a second querying message is sent; otherwise,

a solicit message is sent to the plurality of CCA-capable nodes, and when:

a CCA-capable node responds, an assignment instruction

block assigns the CCA-capable node as the gateway CCA;

otherwise, a second solicit message is sent.

21. The network of Claim 20, wherein when a plurality of CCA-capable nodes respond to the solicit message, the assignment instruction block selects a single CCA-capable node from the plurality of CCA-capable nodes responding to the solicit message, for use by all of the nodes as the gateway CCA.

22. The network of Claim 21, wherein the assignment instruction block comprises:
a determination instruction block for determining a network ID for each of the
plurality of CCA-capable nodes responding; and

5 a selecting instruction block for selecting a CCA-capable node having a lowest
network ID from each of the plurality of CCA-capable nodes responding as the gateway
CCA.

23. The network of Claim 19 further comprising:

10 a designation message for designating one of the plurality of CCA-capable nodes
to be a gateway CCA;

a query message sent from each node for querying the plurality of CCA-capable
nodes to determine whether they are active;

a timeout period where each node waits for a response from each of the plurality
of CCA-capable nodes;

15 a gateway CCA response message, whereby when a gateway CCA response
message is received, a second query message is sent and if no gateway
CCA response message is received an assignment instruction block
changes the CCA-capable node assigned to be the gateway CCA based
upon a response from the plurality of CCA-capable nodes.

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24. The network of Claim 23, when a plurality of CCA-capable nodes respond to the
query message, the assignment instruction block selects a single CCA-capable node from
the plurality of CCA-capable nodes responding to the solicit message, for use by all of
the nodes as the gateway CCA.

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25. The network of Claim 24, wherein the assignment instruction block comprises:
a determination instruction block for determining a network ID for each of the
plurality of CCA-capable nodes responding; and

a selecting instruction block for selecting a CCA-capable node having a lowest network ID from each of the plurality of CCA-capable nodes responding as the gateway CCA.

5 26. The network of Claim 19 further comprising:

 a designation message for designating one of the plurality of CCA-capable nodes to be a gateway CCA;

 a compiling instruction block for compiling a list of CCA-capable nodes on at least one CCA-capable node of the plurality of CCA-capable nodes;

10 a query message sent from the at least one CCA-capable node for querying each CCA-capable node in the list to determine its state, whereby the compiling instruction block updates the list of CCA-capable nodes based on a response from each of the CCA-capable nodes; and checks for a response from the gateway CCA, and when the gateway CCA responds, a second query message is sent; otherwise,

15 a transmitting instruction block transmits the list of CCA-capable nodes to the plurality of nodes in the sub-network; and

 a selecting and assigning instruction block in each node selects and assigns a new gateway CCA from the list of CCA-capable nodes.

20 27. The network of Claim 26, wherein the selecting and assigning instruction block comprises:

 a determination instruction block for determining a network ID for each of the CCA-capable nodes in the list of CCA-capable nodes; and

25 a selecting instruction block for selecting a CCA-capable node having a lowest network ID from the list of CCA-capable nodes as the gateway CCA.

28. The network of Claim 19 further comprising:

a designation instruction block, on at least one CCA-capable node of the plurality of CCA-capable nodes, for designating one of the plurality of CCA-capable nodes to be a gateway CCA;

a query message sent from at least one CCA-capable node of the plurality of CCA-capable nodes for querying each CCA-capable node in the plurality of CCA-capable nodes to determine its state;

a compiling instruction block, on the at least one CCA-capable node, for compiling a list of CCA-capable nodes based on a response from each of the CCA-capable nodes;

a sending instruction block, on the at least one CCA-capable node, for sending the list of CCA-capable nodes to the plurality of nodes in the sub-network; and

a checking instruction block, on the plurality of nodes, for checking the list of CCA-capable nodes for the gateway CCA, whereby when the gateway CCA is in the list of CCA-capable nodes the node waits for the next list of CCA-capable nodes; otherwise,

a selecting and assigning instruction block in each node selects and assigns a new gateway CCA from the list of CCA-capable nodes.

29. The network of Claim 28, wherein the selecting and assigning instruction block comprises:

a determination instruction block for determining a network ID for each of CCA-capable nodes in the list of CCA-capable nodes; and

a selecting instruction block for selecting a CCA-capable node having a lowest network ID from the list of CCA-capable nodes as the gateway CCA.

30. The network of Claim 19 further comprising:

a designation instruction block in each of the CCA-capable nodes for designating one of the plurality of CCA-capable nodes to be a gateway CCA;

a broadcast message sent from each CCA-capable node to the plurality of nodes; and

5 a selecting instruction block in each of the CCA-capable nodes for selecting a gateway CCA based upon a received active message from each CCA-capable node.

31. The network of Claim 30, wherein the selecting instruction block comprises:

10 a hop-count determination instruction block for determining a current hop-count for the message; and

a comparing instruction block for comparing the current hop-count to previous hop-counts from previous messages, and when the current hop-count is less than the previous hop-count selecting the CCA-capable node which broadcast the message as
15 a new gateway CCA.

32. The network of Claim 30, wherein the selecting instruction block comprises:

a current time determination instruction block for determining a current time at which the message was received;

20 a retrieving instruction block for retrieving a gateway time at which a message from the gateway CCA was received; and

a selecting and assigning instruction block for selecting and assigning a new gateway CCA based upon a result of a user-specified formula for comparing the current time and the gateway time.

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33. The network of Claim 19 further comprising:

a designation instruction block in each of the CCA-capable nodes for designating one of the plurality of CCA-capable nodes to be a gateway CCA;

a transmitting instruction block for transmitting a vote from each CCA-capable node to all other CCA-capable nodes designating which CCA-capable node should become a subsequent gateway CCA; and

5 a tallying instruction block in each of the CCA-capable nodes for tallying said votes for each CCA-capable node, whereby when one CCA-capable node receives more votes than any of the other CCA-capable nodes,

an assigning instruction block assigns the one CCA-capable node to become the new gateway CCA, otherwise

the transmitting instruction block transmits a second vote.

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34. The network of Claim 33 further comprising a determination instruction block for determining if at least 2/3 of the plurality of CCA-capable nodes are active, and wherein at least 2/3 of the CCA-capable nodes must respond before the transmitting instruction block transmits a vote.

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35. The network of Claim 19, wherein the network is an ad-hoc network.

36. The network of Claim 19, wherein at least a portion of the plurality of nodes and CCA-capable nodes are mobile.

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37. A computer-readable medium having computer-executable instructions for performing a method comprising actions of:

associating a plurality of nodes with a sub-network, each of said plurality of nodes capable of sending and receiving data;

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adding a plurality of cross layer communication agent capable nodes, herein referred to as CCA-capable nodes, to said sub-network, said plurality of CCA-capable nodes capable of receiving data from and sending data to said plurality of nodes; and

determining which one of the plurality of CCA-capable nodes should be assigned to be a gateway CCA, whereby said gateway CCA is used by each one of said plurality of nodes within said sub-network to communicate with the rest of the network.

- 5 38. The computer-readable medium of Claim 37, wherein the act of determining further comprises sub-acts of:

designating one of the plurality of CCA-capable nodes as the gateway CCA;

querying the gateway CCA from each node to determine whether it is active and awaiting a response, and when:

- 10 the gateway CCA responds, repeating the querying act; otherwise,
 broadcasting a solicit message for receipt by CCA-capable nodes
 and awaiting a response, and when:
 a CCA-capable node responds, assigning a CCA-capable
 node as the gateway CCA; otherwise, repeating the broadcasting
15 act.

39. The computer-readable medium of Claim 38, wherein when a plurality of CCA-capable nodes respond, selecting from the plurality of CCA-capable nodes responding, a single CCA-capable node for use by all of the nodes as the gateway CCA.

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40. The computer-readable medium of Claim 39, wherein the act of selecting from the plurality of CCA-capable nodes responding comprises acts of:

determining a network ID for each of the plurality of CCA-capable nodes responding; and

- 25 selecting a CCA-capable node having a lowest network ID from each of the plurality of CCA-capable nodes responding as the gateway CCA.

41. The computer-readable medium of Claim 37, wherein said act of determining further comprises acts of:

designating one of the plurality of CCA-capable nodes to be a gateway CCA;
querying the plurality of CCA-capable nodes, from each node, to determine
whether they are active and awaiting a response, and when:

5 the gateway CCA responds, repeating the querying act; otherwise,
 changing the CCA-capable node assigned to be the gateway CCA
 based upon a response from the plurality of CCA-capable nodes.

42. The computer-readable medium of Claim 41, wherein when a plurality of CCA-
capable nodes respond, selecting from the plurality of CCA-capable nodes responding, a
10 single CCA-capable node for use by all of the nodes as the gateway CCA.

43. The computer-readable medium of Claim 42, wherein the act of selecting from
the plurality of CCA-capable nodes responding comprises acts of:
 determining a network ID for each of the plurality of CCA-capable nodes
15 responding; and
 selecting a CCA-capable node having a lowest network ID from each of the
plurality of CCA-capable nodes responding as the gateway CCA.

44. The computer-readable medium of Claim 37 wherein said act of determining
20 further comprises acts of:
 designating one of the plurality of CCA-capable nodes to be a gateway
CCA;
 compiling a list of CCA-capable nodes on at least one CCA-capable node
of the plurality of CCA-capable nodes;
25 querying each CCA-capable node, from the at least one CCA-capable
node, in the list to determine its state;
 updating the list of CCA-capable nodes based on a response from each of
the CCA-capable nodes; and
 checking for a response from the gateway CCA, and when:

the gateway CCA responds, repeating the querying act; otherwise,
transmitting the list of CCA-capable nodes to the plurality of nodes
in the sub-network; and
selecting and assigning a new gateway CCA from the list of CCA-
capable nodes.

45. The computer-readable medium of Claim 44, wherein the act of selecting and
assigning a new gateway CCA comprises acts of:

determining a network ID for each of the CCA-capable nodes in the list of CCA-
capable nodes; and
selecting a CCA-capable node having a lowest network ID from the list of CCA-
capable nodes as the gateway CCA.

46. The computer-readable medium of Claim 37, wherein the act of determining
further comprises acts of:

designating one of the plurality of CCA-capable nodes to be a gateway
CCA;

querying each CCA-capable node, from at least one CCA-capable node of
the plurality of CCA-capable nodes, in the plurality of CCA-capable nodes
to determine its state;

updating a list of CCA-capable nodes, stored on the at least one CCA-
capable node, based on a response from each of the CCA-capable nodes;
sending, from the at least one CCA-capable node, the list of CCA-capable
nodes to the plurality of nodes in the sub-network;

waiting to repeat the querying act; and
checking, by at least one node in the plurality of nodes, the list of CCA-
capable nodes for the gateway CCA, and when:

the gateway CCA is in the list of CCA-capable nodes waiting for
the next list of CCA-capable nodes; otherwise,

selecting and assigning a new gateway CCA from the list of
CCA-capable nodes.

47. The computer-readable medium of Claim 46, wherein the act of selecting and
5 assigning from the list of CCA-capable nodes comprises acts of:

determining a network ID for each of CCA-capable nodes in the list of CCA-
capable nodes; and

selecting a CCA-capable node having a lowest network ID from the list of CCA-
capable nodes as the gateway CCA.

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48. The computer-readable medium of Claim 37 wherein the act of determining
further comprises acts of:

designating one of the plurality of CCA-capable nodes to be a gateway
CCA;

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broadcasting a message from each CCA-capable node to the plurality of
nodes; and

selecting a gateway CCA based upon the message from each CCA-capable
node.

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49. The computer-readable medium of Claim 48 wherein the act of selecting further
comprises acts of:

determining a current hop-count for the message; and

comparing the current hop-count to previous hop-counts from previous
messages, and when the current hop-count is less than the previous hop-count selecting

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the CCA-capable node which broadcast the message as a new gateway CCA.

50. The computer-readable medium of Claim 49 wherein the act of selecting further
comprises acts of:

determining a current time at which the message was received;

retrieving a gateway time at which a message from the gateway CCA was received; and

selecting and assigning a new gateway CCA based upon a result of a user-specified formula for comparing the current time and the gateway time.

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51. The computer-readable medium of Claim 37 wherein said act of determining further comprises acts of:

designating one of the plurality of CCA-capable nodes to be a gateway CCA;

transmitting a vote from each CCA-capable node to all other CCA-capable nodes

10 designating which CCA-capable node should become a subsequent gateway CCA; and

tallying said votes for each CCA-capable node, and when:

one CCA-capable node receives more votes than any of the other CCA-capable nodes,

assigning the one CCA-capable node to become the new gateway CCA,

15 otherwise

repeating the transmitting act.

52. The computer-readable medium of Claim 51 further comprising an act of determining if at least 2/3 of the plurality of CCA-capable nodes are active, and wherein
20 at least 2/3 of the CCA-capable nodes must respond before performing the act of transmitting the vote.

53. The computer-readable medium of Claim 37 wherein the act of associating the plurality of nodes further comprises an act of associating the plurality of nodes in an ad-
25 hoc manner.

54. The computer-readable medium of Claim 37 further comprising an act of allowing at least a portion of the plurality of nodes and CCA-capable nodes to be mobile.

55. A method for network communications, the method comprising actions of:

associating a node with a sub-network, the node capable of sending data to and receiving data from a plurality of CCA-capable nodes; and

determining which one of the plurality of CCA-capable nodes should be assigned to be a gateway CCA, whereby said gateway CCA is used by the node within said sub-network to communicate with the rest of the network.

56. The method of Claim 55, wherein the node further performs the acts of:

designating one of the plurality of CCA-capable nodes as the gateway CCA;

querying the gateway CCA from each node to determine whether it is active and awaiting a response, and when:

the gateway CCA responds, repeating the querying act; otherwise,

broadcasting a solicit message for receipt by CCA-capable nodes and awaiting a response, and when:

a CCA-capable node responds, assigning a CCA-capable node as the gateway CCA; otherwise, repeating the broadcasting act.

57. The method of Claim 56, wherein when a plurality of CCA-capable nodes

respond, selecting from the plurality of CCA-capable nodes responding, a single CCA-capable node for use by all of the nodes as the gateway CCA.

58. The method of Claim 57, wherein the act of selecting from the plurality of CCA-capable nodes responding comprises acts of:

determining a network ID for each of the plurality of CCA-capable nodes responding; and

selecting a CCA-capable node having a lowest network ID from each of the plurality of CCA-capable nodes responding as the gateway CCA.

59. The method of claim 55 wherein said act of determining further comprises acts of:
designating one of the plurality of CCA-capable nodes to be a gateway CCA;
querying the plurality of CCA-capable nodes to determine whether they are active
and awaiting a response, and when:

5 the gateway CCA responds, repeating the querying act; otherwise,
 changing the CCA-capable node assigned to be the gateway CCA
 based upon a response from the plurality of CCA-capable nodes.

60. The method of Claim 59, wherein when a plurality of CCA-capable nodes
10 respond, selecting from the plurality of CCA-capable nodes responding, a single CCA-
capable node for use by all of the nodes as the gateway CCA.

61. The method of Claim 60, wherein the act of selecting from the plurality of CCA-
capable nodes responding comprises acts of:

15 determining a network ID for each of the plurality of CCA-capable nodes
responding; and
 selecting a CCA-capable node having a lowest network ID from each of the
plurality of CCA-capable nodes responding as the gateway CCA.

62. The method of claim 55 wherein the act of associating a node further comprises
20 an act of associating the node in an ad-hoc manner.

63. The method of claim 55 further comprising an act of providing a node capable of
being mobile.

25 64. A node comprising:
a transmitting and receiving instruction block for communicating with a sub-
network, the sub-network comprising of nodes and a plurality of cross layer
communication agent capable nodes, herein referred to as CCA-capable nodes; and

a determination instruction block for the node to determine which CCA-capable node should be assigned to be a gateway CCA, whereby the gateway CCA is used by the node to communicate with a second sub-network.

5 65. The node of Claim 64, wherein the determination instruction block further comprises:

 a designation instruction block for designating one of the plurality of CCA-capable nodes as the gateway CCA;

 a querying message sent to the gateway CCA to determine whether the gateway
10 CCA is active;

 a timeout period where the node waits for a response from the gateway CCA, and when:

 the gateway CCA responds, a second querying message is sent; otherwise,
 a solicit message is sent to the plurality of CCA-capable nodes, and when:

15 a CCA-capable node responds, an assignment instruction
 block assigns the CCA-capable node as the gateway CCA;
 otherwise, a second solicit message is sent.

20 66. The node of Claim 64, wherein when a plurality of CCA-capable nodes respond to the solicit message, the assignment instruction block selects a single CCA-capable node from the plurality of CCA-capable nodes responding to the solicit message, for use by the node as the gateway CCA.

25 67. The node of Claim 66, wherein the assignment instruction block comprises:
 a determination instruction block for determining a network ID for each of the plurality of CCA-capable nodes responding; and
 a selecting instruction block for selecting a CCA-capable node having a lowest network ID from each of the plurality of CCA-capable nodes responding as the gateway CCA.

68. The node of Claim 64, wherein the determination instruction block further comprises:

a designation message for designating one of the plurality of CCA-capable nodes
5 to be a gateway CCA;

a query message for querying the plurality of CCA-capable nodes to determine whether they are active;

a timeout period where the node waits for a response from each of the plurality of CCA-capable nodes;

10 a gateway CCA response message, whereby when a gateway CCA response message is received, a second query message is sent and if no gateway CCA response message is received an assignment instruction block changes the CCA-capable node assigned to be the gateway CCA based upon a response from the plurality of CCA-capable nodes.

15 69. The node of Claim 68, when a plurality of CCA-capable nodes respond to the query message, the assignment instruction block selects a single CCA-capable node from the plurality of CCA-capable nodes responding to the solicit message, for use by the node as the gateway CCA.

20 70. The node of Claim 69, wherein the assignment instruction block comprises:

a determination instruction block for determining a network ID for each of the plurality of CCA-capable nodes responding; and

25 a selecting instruction block for selecting a CCA-capable node having a lowest network ID from each of the plurality of CCA-capable nodes responding as the gateway CCA.

71. A computer-readable medium having computer-executable instructions on a node for performing a method comprising actions of:

associating the node with a sub-network, the node capable of sending and receiving data to and from a plurality of CCA-capable nodes; and

determining which one of the plurality of CCA-capable nodes should be assigned to be a gateway CCA, whereby said gateway CCA is used by the node within said sub-
5 network to communicate with the rest of the network.

72. The computer-readable medium of Claim 71, wherein the act of determining further comprises sub-acts of:

designating one of the plurality of CCA-capable nodes as the gateway CCA;

10 querying the gateway CCA from the node to determine whether it is active and awaiting a response, and when:

the gateway CCA responds, repeating the querying act; otherwise,

broadcasting a solicit message for receipt by CCA-capable nodes and awaiting a response, and when:

15 a CCA-capable node responds, assigning a CCA-capable node as the gateway CCA; otherwise, repeating the broadcasting act.

73. The computer-readable medium of Claim 72, wherein when a plurality of CCA-capable nodes respond, selecting from the plurality of CCA-capable nodes responding, a
20 single CCA-capable node for use by the node as the gateway CCA.

74. The computer-readable medium of Claim 73, wherein the act of selecting from the plurality of CCA-capable nodes responding comprises acts of:

25 determining a network ID for each of the plurality of CCA-capable nodes responding; and

selecting a CCA-capable node having a lowest network ID from each of the plurality of CCA-capable nodes responding as the gateway CCA.

75. The computer-readable medium of Claim 71, wherein said act of determining further comprises acts of:

designating one of the plurality of CCA-capable nodes to be a gateway CCA;

querying the plurality of CCA-capable nodes to determine whether they are active

5 and awaiting a response, and when:

the gateway CCA responds, repeating the querying act; otherwise,

changing the CCA-capable node assigned to be the gateway CCA

based upon a response from the plurality of CCA-capable nodes.

10 76. The computer-readable medium of Claim 75, wherein when a plurality of CCA-capable nodes respond, selecting from the plurality of CCA-capable nodes responding, a single CCA-capable node for use by the node as the gateway CCA.

77. The computer-readable medium of Claim 76, wherein the act of selecting from
15 the plurality of CCA-capable nodes responding comprises acts of:

determining a network ID for each of the plurality of CCA-capable nodes

responding; and

selecting a CCA-capable node having a lowest network ID from each of the

plurality of CCA-capable nodes responding as the gateway CCA.

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78. A method for network communications, the method comprising acts of:

associating a CCA-capable node with a sub-network, the sub-network comprising a plurality of CCA-capable nodes, the CCA-capable node capable of sending and receiving data to and from nodes within the sub-network; and

25 determining if the CCA-capable node should be assigned to be a gateway CCA, whereby said gateway CCA is used by the nodes within the sub-network to communicate with the rest of the network.

79. The method of Claim 78, wherein said act of determining further comprises acts of:

designating one of the plurality of CCA-capable nodes to be a gateway CCA;

5 compiling a list of CCA-capable nodes on at least one CCA-capable node of the plurality of CCA-capable nodes;

querying each CCA-capable node, from the at least one CCA-capable node, in the list to determine its state;

10 updating the list of CCA-capable nodes based on a response from each of the CCA-capable nodes; and

checking for a response from the gateway CCA, and when:

the gateway CCA responds, repeating the querying act; otherwise,

transmitting the list of CCA-capable nodes to the plurality of nodes in the sub-network; and

15 selecting and assigning a new gateway CCA from the list of CCA-capable nodes.

80. The method of Claim 79, wherein the act of selecting and assigning a new gateway CCA comprises acts of:

20 determining a network ID for each of the CCA-capable nodes in the list of CCA-capable nodes; and

selecting a CCA-capable node having a lowest network ID from the list of CCA-capable nodes as the gateway CCA.

81. The method of claim 78, wherein the act of determining further comprises acts of:

25 designating one of the plurality of CCA-capable nodes to be a gateway CCA;

querying each CCA-capable node, from at least one CCA-capable node in the plurality of CCA-capable nodes, in the plurality of CCA-capable nodes to determine its state;

updating a list of CCA-capable nodes, stored on the at least on CCA-capable node, based on a response from each of the CCA-capable nodes; sending, from the at least one CCA-capable node, the list of CCA-capable nodes to the plurality of nodes in the sub-network;

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waiting to repeat the querying act; and

checking, by at least one node in the plurality of nodes, the list of CCA-capable nodes for the gateway CCA, and when:

the gateway CCA is in the list of CCA-capable nodes waiting for the next list of CCA-capable nodes; otherwise,

10

selecting and assigning a new gateway CCA from the list of CCA-capable nodes.

82. The method of Claim 81, wherein the act of selecting and assigning from the list of CCA-capable nodes comprises acts of:

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determining a network ID for each of CCA-capable nodes in the list of CCA-capable nodes; and

selecting a CCA-capable node having a lowest network ID from the list of CCA-capable nodes as the gateway CCA.

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83. The method of Claim 78, wherein the act of determining further comprises acts of:

designating one of the plurality of CCA-capable nodes to be a gateway CCA;

25

broadcasting a message from each CCA-capable node to the plurality of nodes; and

selecting a gateway CCA based upon the message from each CCA-capable node.

84. The method of Claim 83, wherein the act of selecting further comprises acts of:

determining a current hop-count for the message; and
comparing the current hop-count to previous hop-counts from previous
messages, and when the current hop-count is less than the previous hop-count selecting
the CCA-capable node which broadcast the message as a new gateway CCA.

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85. The method of Claim 83, wherein the act of selecting further comprises acts of:
determining a current time at which the message was received;
retrieving a gateway time at which a message from the gateway CCA was
received; and

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selecting and assigning a new gateway CCA based upon a result of a user-
specified formula for comparing the current time and the gateway time.

86. The method of Claim 78, wherein said act of determining further comprises acts
of:

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designating one of the plurality of CCA-capable nodes to be a gateway CCA;
transmitting a vote from each CCA-capable node to all other CCA-capable nodes
designating which CCA-capable node should become a subsequent gateway CCA; and
tallying said votes for each CCA-capable node, and when:

20

one CCA-capable node receives more votes than any of the other CCA-
capable nodes,

assigning the one CCA-capable node to become the new gateway CCA,
otherwise

repeating the transmitting act.

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87. The method of claim 86 further comprising an act of determining if at least 2/3 of
the plurality of CCA-capable nodes are active, and wherein at least 2/3 of the CCA-
capable nodes must respond before performing the act of transmitting the vote.

88. A CCA-capable node comprising:

a first transmitting and receiving instruction block for communicating with a sub-network, the CCA-capable node capable of sending data to and receiving data from nodes within the sub-network; and

5 a determination instruction block for determining if the CCA-capable node should be assigned to be a gateway CCA, whereby said gateway CCA is used by the nodes within the sub-network to communicate with the rest of the network.

89. The CCA-capable node of Claim 88, wherein the determination instruction block further comprises:

10 a designation message for designating one of the plurality of CCA-capable nodes to be a gateway CCA;

a compiling instruction block for compiling a list of CCA-capable nodes;

a query message sent from the CCA-capable node for querying each CCA-capable node in the list to determine its state, whereby the compiling instruction block
15 updates the list of CCA-capable nodes based on a response from each of the CCA-capable nodes, and checks for a response from the gateway CCA, and when the gateway CCA responds, a second query message is sent; otherwise,

a transmitting instruction block transmits the list of CCA-capable nodes to the plurality of nodes in the sub-network; and a selecting and assigning
20 instruction block in each node selects and assigns a new gateway CCA from the list of CCA-capable nodes.

90. The CCA-capable node of Claim 89, wherein the selecting and assigning instruction block comprises:

25 a determination instruction block for determining a network ID for each of the CCA-capable nodes in the list of CCA-capable nodes; and

a selecting instruction block for selecting a CCA-capable node having a lowest network ID from the list of CCA-capable nodes as the gateway CCA.

91. The CCA-capable node of Claim 88 further comprising:

a designation instruction block for designating one of the plurality of CCA-capable nodes to be a gateway CCA;

a query message sent from the CCA-capable node for querying each CCA-capable node in the plurality of CCA-capable nodes to determine its state;

a compiling instruction block for compiling a list of CCA-capable nodes based on a response from each of the CCA-capable nodes;

a sending instruction block for sending the list of CCA-capable nodes to the plurality of nodes in the sub-network; and

a checking instruction block for checking the list of CCA-capable nodes for the gateway CCA, whereby when the gateway CCA is in the list of CCA-capable nodes the node waits for the next list of CCA-capable nodes; otherwise,

a selecting and assigning instruction block in each node selects and assigns a new gateway CCA from the list of CCA-capable nodes.

92. The CCA-capable node of Claim 91, wherein the selecting and assigning instruction block comprises:

a determination instruction block for determining a network ID for each of CCA-capable nodes in the list of CCA-capable nodes; and

a selecting instruction block for selecting a CCA-capable node having a lowest network ID from the list of CCA-capable nodes as the gateway CCA.

93. The CCA-capable node of Claim 88 further comprising:

a designation instruction block for designating one of the plurality of CCA-capable nodes to be a gateway CCA;

a broadcast message sent from the CCA-capable node to the plurality of nodes; and

a selecting instruction block for selecting a gateway CCA based upon a received active message from each CCA-capable node.

94. The CCA-capable node of Claim 93, wherein the selecting instruction block
5 comprises:

a hop-count determination instruction block for determining a current hop-count for the message; and

a comparing instruction block for comparing the current hop-count to previous hop-counts from previous messages, and when the current hop-count is less than
10 the previous hop-count selecting the CCA-capable node which broadcast the message as a new gateway CCA.

95. The CCA-capable node of Claim 93, wherein the selecting instruction block comprises:

15 a current time determination instruction block for determining a current time at which the message was received;

a retrieving instruction block for retrieving a gateway time at which a message from the gateway CCA was received; and

a selecting and assigning instruction block for selecting and assigning a
20 new gateway CCA based upon a result of a user-specified formula for comparing the current time and the gateway time.

96. The CCA-capable node of Claim 88 further comprising:

a designation instruction block for designating one of the plurality of CCA-
25 capable nodes to be a gateway CCA;

a transmitting instruction block for transmitting a vote from the CCA-capable node to all other CCA-capable nodes designating which CCA-capable node should become a subsequent gateway CCA; and

a tallying instruction block in the CCA-capable node for tallying said votes for each CCA-capable node, whereby when one CCA-capable node receives more votes than any of the other CCA-capable nodes,

an assigning instruction block for assigning the one CCA-capable node to
5 become the new gateway CCA, otherwise

the transmitting instruction block transmits a second vote.

97. The network of Claim 96 further comprising a determination instruction block for determining if at least 2/3 of the plurality of CCA-capable nodes are active, and wherein
10 at least 2/3 of the CCA-capable nodes must respond before the transmitting instruction block transmits a vote.

98. A computer-readable medium for enabling a CCA-capable node, the computer-readable medium having computer-executable instructions on a CCA-capable node for
15 performing a method comprising actions of:

associating a CCA-capable node with a sub-network, the CCA-capable node capable of sending and receiving data to and from nodes within the sub-network; and
determining if the CCA-capable node should be assigned to be a gateway CCA,
whereby said gateway CCA is used by the nodes within the sub-network to communicate
20 with the rest of the network.

99. The computer-readable medium of Claim 98, wherein said act of determining further comprises acts of:

designating one of the plurality of CCA-capable nodes to be a gateway
25 CCA;

compiling a list of CCA-capable nodes on at least one CCA-capable node of the plurality of CCA-capable nodes;

querying each CCA-capable node, from the at least one CCA-capable node, in the list to determine its state;

updating the list of CCA-capable nodes based on a response from each of the CCA-capable nodes; and

checking for a response from the gateway CCA, and when:

the gateway CCA responds, repeating the querying act; otherwise,

5 transmitting the list of CCA-capable nodes to the plurality of nodes in the sub-network; and

selecting and assigning a new gateway CCA from the list of CCA-capable nodes.

100. The computer-readable medium of Claim 99, wherein the act of selecting and
10 assigning a new gateway CCA comprises acts of:

 determining a network ID for each of the CCA-capable nodes in the list of CCA-capable nodes; and

 selecting a CCA-capable node having a lowest network ID from the list of CCA-capable nodes as the gateway CCA.

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101. The computer-readable medium of claim 98, wherein the act of determining further comprises acts of:

 designating one of the plurality of CCA-capable nodes to be a gateway CCA;

20

 querying each CCA-capable node, from at least one CCA-capable node in the plurality of CCA-capable nodes, in the plurality of CCA-capable nodes to determine its state;

 updating a list of CCA-capable nodes, stored on the at least one CCA-capable node, based on a response from each of the CCA-capable nodes;

25

 sending, from the at least one CCA-capable node, the list of CCA-capable nodes to the plurality of nodes in the sub-network;

 waiting to repeat the querying act; and

 checking, by at least one node in the plurality of nodes, the list of CCA-capable nodes for the gateway CCA, and when:

the gateway CCA is in the list of CCA-capable nodes waiting for the next list of CCA-capable nodes; otherwise,
selecting and assigning a new gateway CCA from the list of CCA-capable nodes.

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102. The computer-readable medium of Claim 101, wherein the act of selecting and assigning from the list of CCA-capable nodes comprises acts of:

determining a network ID for each of CCA-capable nodes in the list of CCA-capable nodes; and

10 selecting a CCA-capable node having a lowest network ID from the list of CCA-capable nodes as the gateway CCA.

103. The computer-readable medium of Claim 98, wherein the act of determining further comprises acts of:

15 designating one of the plurality of CCA-capable nodes to be a gateway CCA;

broadcasting a message from each CCA-capable node to the plurality of nodes; and

20 selecting a gateway CCA based upon the message from each CCA-capable node.

104. The computer-readable medium of Claim 103, wherein the act of selecting further comprises acts of:

determining a current hop-count for the message; and

25 comparing the current hop-count to previous hop-counts from previous messages, and when the current hop-count is less than the previous hop-count selecting the CCA-capable node which broadcast the message as a new gateway CCA.

105. The computer-readable medium of Claim 103, wherein the act of selecting further comprises acts of:

determining a current time at which the message was received;

retrieving a gateway time at which a message from the gateway CCA was

5 received; and

selecting and assigning a new gateway CCA based upon a result of a user-specified formula for comparing the current time and the gateway time.

106. The computer-readable medium of Claim 98, wherein said act of determining

10 further comprises acts of:

designating one of the plurality of CCA-capable nodes to be a gateway CCA;

transmitting a vote from each CCA-capable node to all other CCA-capable nodes

designating which CCA-capable node should become a subsequent gateway CCA; and

tallying said votes for each CCA-capable node, and when:

15 one CCA-capable node receives more votes than any of the other CCA-capable nodes,

assigning the one CCA-capable node to become the new gateway CCA,
otherwise

repeating the transmitting act.

20

107. The computer-readable medium of claim 106 further comprising an act of

determining if at least 2/3 of the plurality of CCA-capable nodes are active, and wherein

25 at least 2/3 of the CCA-capable nodes must respond before performing the act of transmitting the vote.